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on the Comparative Advantage of China's Auto Engineering Industry

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Abstract

The industry of auto engineering becomes one important mainstay industry to Chinese economy along with market economic development. This paper employs the principal components analysis with the SPSS19.0 statistical analysis software to evaluate comparative advantage of China's auto industry. It presents the evaluation indexes, including the market structure, economies of scale, product heterogeneity, related industries, technology, resources, human capital and organization. The conclusions are drawn as follows: The trend of comparative advantage of China's Auto industry gradually increased from 1998 to 2009, which from minus 0.05 to 0.86, almost increased by nearly 16 times. Meanwhile, technology, logistics and comprehensive factor become the core three factors to comparative advantage of China's auto industry. Therefore, to improve the comparative advantage of China's auto industry, both the relevant enterprises and the government should take effective measures to inspirit and maximum these useful factors.

Keywords: the Comparative Advantage; China's Auto Engineering; Evaluation; Principal Component Analysis

1. Introduction

The comparative advantage (CA) is the foundation of international trade theory, was firstly proposed by Torrens in the paper of "An Essay on the External Corn Trade" in 1815. Overall, most scholars agree that the logic line of international trade theory is: the classical theory of comparative advantage trade theory composed by theory of absolute advantage (Smith, 1776) [1] and the comparative advantage (Ricardo, 1817) [2]; to the neo-classical trade theory composed by the factor endowment theory (Heckscher, 1919, Ohlin, 1933) [3] and the resource endowment theory (Samuelson, 1941) [4], to the new trade theory (Krugman, Helpman, Grossman, 1980s) [5]; to the new classical trade theory (Xiaokai Young,1990s) [6]. The first two are collectively known as the traditional theory of comparative advantage; the latter two are often referred to the modern theory of comparative advantage.

Just as assumptions and explanations of each theory exists differences, so CA is the conclusions of paired comparison, whether it caused by production technology and factor endowments or economies of scale and transaction costs. This article puts forward that CA is the efficiency advantage, as long as a country has the higher

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efficiency in a product exchange or production compared to other countries, regardless what led to this relatively high efficiency. That is to say, the country has a comparative advantage in the products of higher efficiency.

The article chooses three typical countries of auto production to do the comparative research to China, including America, Japan and Germany. The auto productions from 1970 to 2009 of these four are shown in figure 1. America was top one of auto producing before 1978. Experiencing a zigzag from 1975 to 1995, it returned to the top one of auto producing in 1994 and remained the advantage to 2006. For Japan, it had a fast and stable development in 1970s and become the top one in 1990, after that time, it remain the production of 10, billion vehicles every year. For Germany, it remained the production of nearly 6 billion. All the three developed countries had a mature market and had a stable development. Last but not the least; we can see China's auto industry developed quickly. China has become the world's largest producer of vehicles in 2009, and has formed a multi-species, the full range of types of vehicle and parts production and supporting systems.

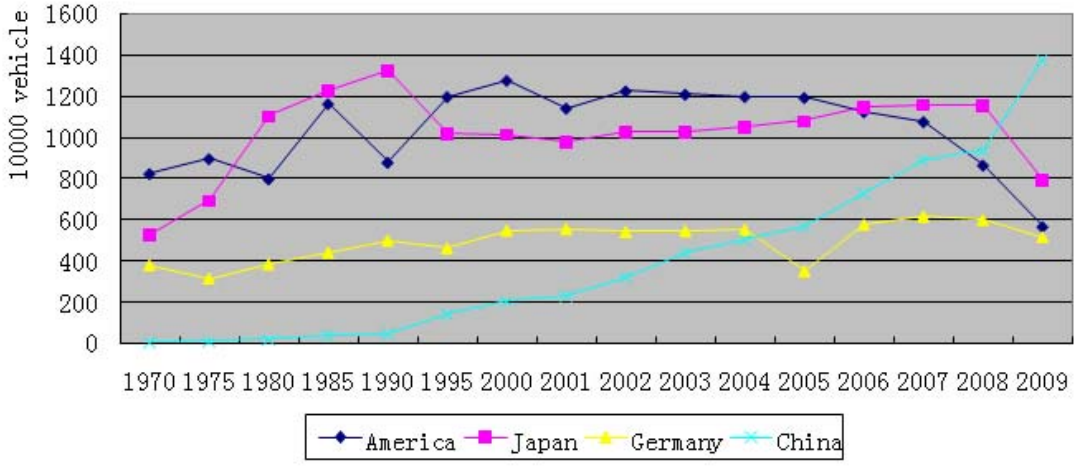

Fig.1. 1970-2009 the auto production of four main countries

Source of data: *Automotive Industry Yearbook of China 2010*

2. The Evaluation Index of CA of China's Auto Industry

According to the principles of comprehensiveness, representativeness, comparability and stability, scientific and practical on choosing index, this article evaluates the performance China's auto industry from 12 factors, including the market structure, economies of scale, product heterogeneity, related industries, technology, resources, human capital and organization, which are shown in Table 1.

Table 1. The evaluation index of CA of China's auto industry

No.	Evaluation index	Choose reason
X_1	Concentration of production CR_4	Market structure
X_2	Degree of economies of scale	Management
X_3	Numbers of brand	Product heterogeneity
X_4	Production of Automobile engine	Upwards industries
X_5	Road freight turnover / total turnover of goods	Downward industries
X_6	Road passenger turnover / total passenger turnover	Downward industries
X_7	R&D Input intensity	Technology
X_8	Oil consumption	Upwards industries
X_9	Steal consumption	Upwards industries
X_{10}	Labour productivity	Human capital
X_{11}	Industrial output	Organization
X_{12}	Industrial added value	Organization

Among the above mentioned elements,

X_1 is the proportion between the output of the first four of the auto companies and the country's total output [7].

X_2 is the total output of the companies whose are more than 100,000.

To X_5, road freight turnover refers to the total amounts of variety road transport tools in the actual delivery of goods to the destination and emptied.

To X_6, road passenger turnover refers to the total amounts of visitors during the actual delivery of the transport multiplied their corresponding distance.

To X_7, R & D investment intensity is R & D expenses divided by sales.

3. The Evaluation Model of CA of China's Auto Industry

3.1 Data Standardization

Because of the different dimensions, the original indexes can't be compared directly and should be standardized. The original indexes of The CA of China's Auto industry can be standardized using the following formula.

$$x_{ik} = \frac{X_{ik} - X_i^{min}}{X_i^{max} - X_i^{min}} \qquad (1)$$

In which, x_{ik} stands for the k[th] value of i-level indicators.

$X_i^{\min}$ stands for the minimum value of the i-level indicators.

$X_i^{\max}$ stands for the maximum value of the i-level indicators.

3.2Principal Components Analysis

Principal components analysis belongs to factor analysis, which is a statistical analysis that can reflect the basic data structure from few variables. It's firstly proposed by C.E. Spearman, a British psychologist. It constructs a common factor to explain the strong intrinsic relationship between the variables based on the intrinsic relationship of samples. It divided the indexes into different groups According to the relationship size of the variables, within the same group a strong correlation between variables and different groups of low correlation between variables; each group represents a basic structure of the "common factor". Therefore, Factor analysis can summarize information existed in all types of variables with a relatively few indicators, and integrates the dispersion indexes, to find out the basic structure and decrease the relationship between the observed data, and avoid the problem of variable collinearity.

3.3 Principal Components Analysis on China's Auto Industry

This article used the method of principal component analysis with SPSS16.0 statistical analysis software to evaluate CA of China's Auto industry, which used the varimax for the orthogonal rotation and selected the factors whose eigenvalue is greater than one [8]. After input the standardized indexes of China's Auto industry, the software recommended three principal components, whose cumulative contribution rate is 94.31%, far greater than the reference value 85%, could explain most original information of China's Auto industry exactly. Meanwhile, KMO test statistic and the Bartlett test of sphericity showed that the original data satisfied the conditions of normal distribution and is suitable for Principal Components Analysis.

We named the three common factors are Comprehensive factor, technology factor and logistics factor. Table 2 shows information contained in the common factors.

Table 2. the Meanings of Principal Components

Principal Components	explanations	contents
F_1	Comprehensive factor	$X_1,X_2,X_3,X_4,X_6,X_8,X_9,X_{10},X_{11},X_{12}$
F_2	technology factor	X_7
F_3	logistics factor	X_5

3.4 The comprehensive scores

According to the Coefficient matrix of factor scores, we can obtain the functions of factor scores.

$$F_1=0.194X_1+0.102X_2+0.062X_3+0.099X_4-0.071X_5-0.098X_6-0.131X_7+0.124X_8+0.097X_9+0.154X10+0.100X11+0.108X12 \quad (2)$$

$$F_2=(-0.439X_1)+0.029X_2+0.037X_3+0.035X_4-0.099X_5-0.289X_6+0.789X_7+0.015X8+0.098X9-0.207X_{10}+0.011X_{11}-0.003X_{12} \quad (3)$$

$$F_3=(-0.021X_1)+0.028X_2+0.226X_3+0.035X_4+0.770X_5+0.474X_6-0.086X7-0.081X_8-0.042X_9+0.042X_{10}+0.066X_11+0.037X_{12} \quad (4)$$

According to the explanations of General variables of the statistical analysis, the coefficients of three common factors are:

$\alpha 1=70.079/94.317=0.74,$

$\alpha 2=12.582/94.317=0.13,$

$\alpha 3=11.656/94.317=0.12$

Therefore, the comprehensive function of evaluation of CA of China's Auto industry $F(Y_i)$ is as follows:

$$Y_i=0.74F_1+0.13F_2+\ldots\ldots+0.12F_i+\varepsilon \quad (5)$$

According to the formulas (1), (2), (3), (4), (5), we can obtain the comprehensive scores of CA of China's Auto industry, as is shown in figure.

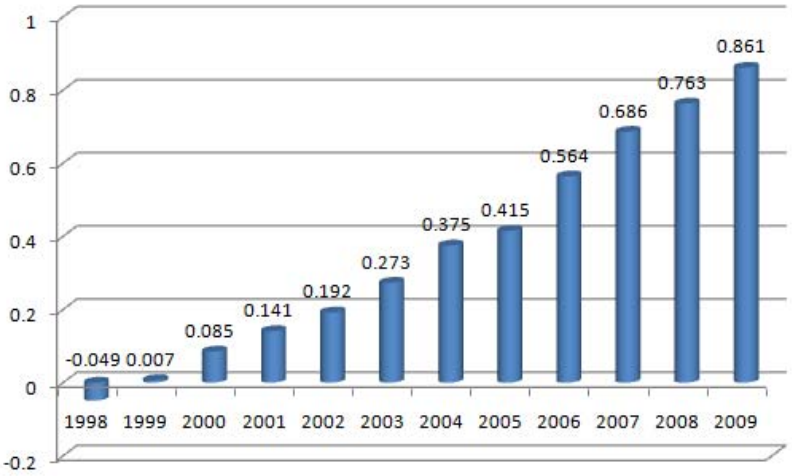

Fig.2. the comprehensive scores of CA of China's auto industry

4. Conclusions

To sum up, the trend of CA of China's auto industry gradually increases from 1998 to 2009, which from minus 0.05 to 0.86, nearly increased by 16 times. More exactly, to CA of China's auto industry, comprehensive factor includes all the indexes except the technology and logistic factor, which means that the market structure, management, human capital, organization of enterprises can affect the China's auto engineering deeply. Meanwhile, technology becomes the core factor to CA of China's auto engineering. The function of logistics factor becomes

more and more important in the fast developed society. Therefore, to improve CA of China's auto engineering, on one hand, the auto and relevant enterprises should pay more attention to standardize their management, give more effective measures to inspirit the passion of staff, advance the enterprise organization. On the other hand, the government should make a series of measures to strength the CA of auto companies, such as encourage merge and acquisitions, learning by doing, etc.

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